STUDIES IN THE BIONOMICS OF CURCULIONIDAE

BY

DONALD MONROE TUTTLE

B.S., Michigan State College, 1940
M.S., Michigan State College, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENTOMOLOGY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1952

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It is with a great deal of pleasure, I express my thanks to Mr. Harry Ahles of the Botany Department for his determinations of species of plants concerned with this study and for his companionship on many field trips to several areas of Illinois. I wish to acknowledge the determinations of plants which Dr. G.N. Jones of the Botany Department made for me and his congenial interest at all times.

To the persons of the United States National Museum, who have made determinations for me, I am very much indebted. For the identification of weevils, I wish to thank Miss Rose Warner and Dr. W.H. Anderson; the braconids, Mr. C.F.W. Muesebeck; other hymenopterous parasites, Mr. A.B. Gahan and Dr. B.D. Burks; and parasitic Diptera, Mr. C.W. Sabrosky.

I am deeply indebted to my wife for her understanding, encouragement, personal sacrifice and for the many hours of typing and helpful suggestions she has given in the preparation of this manuscript.

R. UNIV. BIBLIOTHEEK LEIDEN

STUDIES IN THE BIONOMICS OF CURCULIONIDAE

Introduction

The family Curculionidae is treated herein as a heterogeneous group including the 13 subfamilies recognized by Blatchley and Leng (1916). It has been common practice among some taxonomists in the past few years to remove at least twelve of these subfamilies and raise them to the rank of family. Other workers have recognized from 20 to 40 subfamilies. Since my present interest in the group is based on bionomics, the classification of Blatchley and Leng has been followed because it is more familiar to most of the entomologists.

Undoubtedly, the snout beetles constitute the largest single group of closely related animals. There are approximately 40,000 species known to occur in the world and about 2,000 of these in the United States. During the past three summers I have collected 150 species from Champaign County, Illinois which is certainly not all the species that exist in this county. Altogether, I have assembled a reference collection of 350 species, which occur in the United States.

While the bionomics of some of the species of economic importance have been investigated, information concerning the vast majority is very slight or nil. Occasionally, attempts have been made to compile a list of the food plants but none of these are extensive except that of Blatchley and Leng in their work entitled, "The Rhynchophora or Weevils of North Eastern America".

My investigations reported in this paper have a twofold purpose: first, to study the bionomics of several species encountered in the past three years; and second, to associate all the weevils, which I found, with their host plants. In June 1949, when this study was initiated, I intended to investigate the bionomics of two or three species in detail. However, during the course of my field work in the fall of 1949 and the

spring of 1950, so many interesting plant-beetle associations were discovered that I broadened the scope of the problem to include all these associations I could obtain. Therefore, I have not studied any species in detail, but I have gathered some information on several species.

Bionomics Of Species

The species of the family Curculionidae utilize a great number of different kinds of plants for the purpose of feeding and development. Among the plant families are some belonging to the Monocotyledons and others to the Dicotyledons. Apparently there are very few families of flowering plants which are not inhabited by or fed upon by the weevils. In the course of my investigations I have associated more species of weevils with the family Compositae than any other. There are perhaps two reasons for this. In the first place, the family Compositae is one of the richest families in species and natural abundance, especially in Champaign County, Illinois, where I did most of my work; and secondly, these plants have several anatomical characteristics to which weevils readily adapt themselves. The large flower heads of most of the composites are not only inviting places for adults to feed but also serve as excellent places for oviposition, larval development and pupation for some species of weevils. Often the large leaves of this family provide a place for development as well as food for the adult. However, it is the large pithy stems and succulent roots of composites which are inhabited most frequently by immature stages of weevils.

Usually the species of any one genus of weevils are similar in their pattern of development, and inhabit plants of the same genus or closely related genera. As a rule they also inhabit the same parts of plants, and their seasonal development runs parallel. For example, the nut weevils, *Curculio*, all develop in nuts during the summer and early fall, leave the nuts as mature larvae in the fall and enter the soil. The winter is passed in the larval stage and pupation occurs in late spring. Another interesting genus is that of *Limnobaris*. Species of

this genus inhabit the lower stems of *Scirpus* spp. exclusively so far as I know. Oviposition takes place in early summer and the larvae develop in the stem as they bore downward. Instead of leaving the stem, they remain in the stem over winter as mature larvae and pupation occurs within pupal cells formed in the burrow by the larvae.

I find that weevils are rather specific in regard to the host plants in which they develop. In a few cases, a species of weevil may be monophagous as is the Duck-weed weevil which inhabits only *Lemna minor* so far as I know; and *Apion longirostre* is known only from the common hollyhock, *Althaea rosea.* Other species having a single host plant are *Tyloderma foveolata,* inhabiting the stems of *Oenothera biennis,* and *Anthonomus rufipes,* developing in the flower heads of the New England Aster, and also *Onychobaris subtonsa* which lives in the stems of the umbrella-wort, *Mirabilis nyctaginea.* Then there are those species of curculios which utilize more than one host species of the same genus. Some of these are *Anthonomus albopilosus* which develop in *Croton* spp., *Anthonomus nigrinus* which inhabits various species of the genus *Solanum* and *Miarus hispidulus* living in *Lobelia* spp. Still other species of curculios are able to develop in plants belonging to closely related genera of one family. Three examples of the latter type are *Rhodobaenus tredecimpunctatus* which is capable of utilizing several genera of Compositae for development, *Lixus fimbriolatus* which develops in several species of Compositae belonging to various genera of sunflowers, and *Tyloderma fragariae* which seems to do equally well in two genera of Rosaceae, *Potentilla* spp. and *Fragaria* spp. Finally there are a very few species which have the ability to develop in plants which belong to different families which may or may not be closely related. One of the better known of these is the strawberry root weevil which inhabits the roots of Pinaceae, Cupressaceae, Gramineae, Rosaceae, Ericaceae and possibly Cucurbitaceae. However, it has been proposed by Miss McDaniel (1940) that there may be two races or varieties involved in the case of the strawberry root

weevil.

Occasionally host plants have been reported for a species of curculio which are somewhat removed taxonomically from those which have generally been reported and observed. There is a possibility that insects or plants have been misidentified. Thus, such records must be viewed with skepticism.

The plant hosts given in the literature may be divided into three categories, which are: first, those plants in which weevils actually develop through their immature stages; secondly, plants upon which snout beetles feed but in which they do not develop; and third, those plants upon which weevils may chance to occur temporarily but on which they do not feed and in which they do not develop. The first category, of course, concerns the true plant hosts. Usually the records constituting the third category must be regarded as tentative until it can be shown that the weevils do or do not inhabit the plant or feed upon it.

In the list of weevils which I have collected in Illinois, I have supplemented my own observations of host plants with those from literature. By doing so, the list of host plants is fairly complete. The references to the host plants are cited in each case. Information orginal with me is indicated by my name in parentheses i.e. (Tuttle,1951). Where rather common weevils are dealt with, I supplemented my own records with information from some of the original work selected from the literature. In addition a phrase is included for each host plant denoting the relationship between the weevil and the plant, i.e. to which of the three categories the species belongs. The list of Curculionidae is arranged according to Leng's Catalogue and the numbers given the species by Leng are cited. Under the names of each of the weevils the host plants appear in taxonomic order.

Summary

This thesis deals with 150 species of Curculionidae which were collected mostly in Champaign County, Illinois. The

bionomics of 42 species are recorded in the first part of the manuscript, including information from published literature. The entire 150 species are treated in the plant host index and the curculionid index with host plants.

Among the 150 species of weevils, there are several which could not be associated with known species by specialists at the United States National Museum. Some of these at least may prove to be new species.

My information has been a result of work in the field and the laboratory. Numerous field trips were taken throughout the three years, especially from April to October. It was on these trips that material was obtained and brought into the laboratory for dissection and study as well as for rearing.

VITA

Donald M. Tuttle was born February 1, 1917 in Bay City, Michigan. At the age of seven he moved to the country where he attended a country school. His interest in Entomology was first aroused at the Bay City YMCA camp at McIvor, Michigan when he was eleven. In the same year he joined the 4H club, which played an essential part in his earlier life. After graduating from Bay City Central High School in June 1935, he attended Michigan State College. A scholarship, which was won through his 4H club work, aided him for the first two years of college. During the summers and spare hours he was employed by the Entomology Department to work on various projects and experiments that were being carried out by the department. With a major in Entomology and a minor in Botany, he graduated from Michigan State College in March 1940 with the degree of Bachelor of Science. From March to October 1940 he was employed by the Entomology Department as a laboratory assistant and a technician. Throughout the summer he traveled widely in the state, collecting insects for the Department. From November 1940 to March 1941 he worked in Detroit, Michigan for the Allison Division of the Cadillac Motor Car Company. On April 2, 1941 he was inducted into service at Bay City, Michigan and proceeded to Camp Custer near Battle Creek, Michigan. Basic training was completed in the Quartermasters Corps at Camp Lee, Virginia. In July, 1941 he was sent to Ft. Belvoir, Virginia, as a sanitary technician in the Medical Department of the United States Army. After the declaration of war he proceeded to the Pacific side of the Panama Canal Zone where he was placed in a new General Hospital. It was during this 30 months that he became thoroughly familiar with malaria and other laboratory work. As noncommissioned officer in charge of the laboratory, he supervised from 9 to 17

technicians at various times. After being replaced in May 1944, he returned to the States and was assigned to the Army Medical Center in Washington, D.C. His work here was histopatholgical in nature and assisting with autopsies for a 13 month period. His final 5 months in service were devoted to entomological work under Dr. Luther West at the Army Medical School in Washington, D.C. Following his separation from service in October 1945, he returned to Michigan State College in pursuit of the degree of Master of Science. The summers of 1946 and 1947 were spent at South Haven, Michigan in the employment of the Blueberry Growers Association, studying insect pests and means of their control. After obtaining the degree of Master of Science in August 1947, he accepted a position as instructor at the University of Maine. Here he taught courses in General Entomology, Taxonomy, Aquatic Entomology, Forest Entomology, Advanced Forest Entomology, and Farm Insects. The Maine Agricultural Experiment Station employed him during the summer of 1948 to work on the control of the blueberry maggot. In June of 1949 he came to the University of Illinois in pursuit of the degree of Doctor of Philosophy. During the school years of 1949-50, 1950-51, and 1951-52 he has held a teaching assistantship in the Department of Entomology. An assistantship was also held during the summer of 1950. The summer of 1951 was spent working half time for Dr. H.H. Ross on identification of leafhoppers. Four weeks before the opening of school he worked full time for Dr. G.C. Decker on the Corn Borer Projects.

He is a member of Phi Sigma and Sigma Xi. He is also a member of the American Association of Economic Entomologists, the Entomological Society of America, the American Association for the Advancement of Science and the Society of Systematic Zoology.